PAPERS

IN

MANUFACTURES.

No I.

IMPROVED BLOCKS FOR CALICO-PRINTERS.

The Sum of FIFTEEN GUINEAS *was this Session given to Mr.* STEPHEN MARSHALL, *of Merton Bridge, Surrey, for his* IMPROVED BLOCKS FOR CALICO-PRINTERS, *a Set of which has been placed in the Repository of the Society.*

THE more complicated patterns of printed calicos consisting of figure work and stripes, require the application of two or more blocks; the stripe, or rather three or four parallel stripes, being cut on one block, and the figure-work on another; but where the stripes are cut on a single block the distance between one stripe and another is not susceptible of variation, and therefore can be used in conjunction with those figure-blocks only, the intervals of which correspond with those of the stripe-blocks. In order to render these more extensively applicable,

and at the same time to allow the printer to adjust the intervals of the stripes at pleasure, an improvement was introduced of forming the stripe-block of three separate pieces (corresponding to the number of the stripes) having a horizontal hole bored through them at each end, through which two wooden pins being run, united them into one block, at the same time allowing the printer to set the intervals of the stripes so as to fit those of any particular figure-block which he was desirous of employing.

This advantage had its correspondent inconveniencies; the pieces of the compound block were apt to warp, and thus to injure the parallelism of the stripes; the wooden pins which united them soon became dry from the necessarily high temperature of the workshops, the pieces then got loose, and caused irregularities in the pattern, and when this happened the only remedy was to soak the blocks in water till the pins had swelled, and became sufficiently tight again to retain the pieces at their proper distances; in consequence of which much time was lost to the workman.

Mr. Marshall has discarded the wooden pins heretofore used, and unites the pieces of the stripe-blocks by means of bolts and screws and nuts of metal; the consequence is, that not only are they prevented from warping, but they may be adjusted to any required interval with the utmost precision; a farther advantage also is, that the workman may by this means manage a block of five stripes with the same ease as he now does one of three stripes.

Ample testimonies of the probable advantages of this new invention were forwarded to the Society, by

Mr. Edwards, *of Wandsworth Calico Print Works*
Mr. Geo. Ansell, *of Carshalton.*
Mr. Audsley, *of Crayford.*
Mr. Haite, *of Merton Abbey*, and
Mr. Whitehead, *of Crayford.*

Reference to the Engraving of Mr. MARSHALL'S *Blocks for Calico Printing.*—Plate I.

Fig. 9 is a back view of the block with five rows or boards. Fig. 10 a side view *a a a a a* the boards; *b b* fig. 10, the facing of close-grained wood; *c c* a back-board screwed to the middle bar, with notches at *d d d d* for the side bar screws to slide in; *e e e e* two copper bars passing through the five wooden bars, and fixed to the middle one by pins *f f f f;* these with the back-board *c* serve to keep the face of the bars in one plane; *g g g g* two adjusting-screws fixed to the middle bar by a flat part through which a screw passes, and having two nuts for each lateral bar in order to fix it at the required distance. Fig. 11 shows another method of adjusting by which one nut at each end of a bar serves to move or fix them; the nuts have a collar let into the bar, and followed by a brass-plate, so that when the nut is turned by the octagon part which projects through, the bar is moved backward or forward. Fig. 14 shows the plates *h h* on the inside of one of the bars with the nuts projecting through them. Fig. 12 shows the screw with the nuts and section of the plates *h h* detached. Fig. 13 a copper bar which is fixed in the middle wooden bar by a screw passing through them; *i i i i* screws in the other bars which fix them to the copper bars when adjusted.

Nos II. AND III.

IMPROVEMENT IN THE SILK-WEAVER'S DRAW-BOY.

The Sum of TWENTY GUINEAS *was this Session given to Mr.* E. RICHARDS, *of Bethnal Green, for an* IMPROVEMENT IN THE SILK-WEAVER'S DRAW-BOY.

The Sum of FIVE GUINEAS *was given to Mr.* J. HUGHES, *of Patience Street, Bethnal Green, for an* IMPROVEMENT IN THE SILK-WEAVER'S DRAW-BOY. *A Model of the Improvement has been placed in the Society's Repository.*

IN weaving plain goods of every description composed of silk, wool, hemp, cotton, or flax, the threads composing the warp are formed into two sets, the 1st, 3rd, 5th, &c. forming one division, and the alternate ones, the 2nd, 4th, 6th, &c. forming the other; each set is alternately raised and depressed, and at every crossing of the sets, the shuttle containing a spindle full of thread is shot, or thrown from one hand to the other, distributing the thread in its passage, in front of every intersection of the threads that compose the warp; but in figured silks, the threads of the warp are formed into more divisions than two, the number varying according to the

pattern; and in order that each division may be raised or depressed with the necessary accuracy, each thread of the warp is passed through a loop in a vertical cord furnished with a weight at bottom to keep it properly stretched, and passing over a support at top. These vertical cords are called the monture, and are collected into as many sets or lashes as the pattern requires; it being understood that the cords of those threads which are to be raised or lowered together are to be included in the same lash. The number of lashes required for very simple patterns on very narrow silks is considerable, amounting to 40, 60, or more; it is obviously, therefore, in these cases, impossible to give motion to the warp by attaching a treadle to each lash. The way in which the lashes were actually raised was, to pass the end of each lash through a hole in a horizontal board, to fix to the lash a piece of wood like a bell-pull, and to employ a boy (thence called a draw-boy) in pulling or drawing down each lash in succession, so that the weaver had only to throw the shuttle, and give directions to his boy.

Each cord of a lash having a weight hung to it, the aggregate weight of the whole lash is considerable; so that the labour incurred by the draw-boy was great, and considerable dexterity (the result alone of long practice) was required to prevent mistakes, and much loss of time. Hence the weavers were very dependent on their draw-boys, and the idleness or illness of one of them threw the weaver for the time out of work.

Various ineffectual attempts had been made to supersede the living draw-boy by machinery, but with little if any success, till Mr. Duff brought forward an engine for the purpose, which was rewarded by this Society in 1816. Mr. Duff's engine by means of a very ingenious contrivance enables the weaver by pressing alternately on two pair of treadles to

produce the regular elevation and depression of the lashes without the assistance of the boy. The weight of the lashes and the friction of the machine being considerable, it was necessary to adjust accordingly the length of the levers or treadles by which it was put in motion; in consequence of which a tread of 10 inches was thought necessary, that the weaver might not be oppressed by the weight. It was soon however found in practice that the exertion of raising the feet 10 inches for every motion of the treadle was excessively fatiguing to the weaver, and apparently occasioned a predisposition to rupture, so that the machine came only into very limited use.

About two or three years ago, Mr. Jones, since dead (an engine-maker), attempted to shorten the tread, by fixing on the axis of the driving wheel two cranks each about $\frac{2}{3}$ of the length of the radius of the wheel; but the mechanical disadvantage at which they worked, and the manner in which they were connected with the treadles increased the weight and friction so disproportionately to the advantage gained by shortening the tread, as to render it wholly inapplicable in practice.

About last Christmas, Mr. Hughes, a weaver, fixed a small grooved wheel on the axis of the driving-wheel, and connected it to the treadles by means of two cords passing over pulleys. It might be supposed that any advantage thus gained by shortening the tread would be counter-balanced by the increased weight required to be overcome. This, however, is not practically the case; when the thigh of the weaver is raised so as to be nearly horizontal, as necessarily happens at the commencement of a tread ten inches in height, the muscular force which can be exerted by a given effort is far inferior to that which an equal effort will produce in a tread of five inches; and hence, although the weight to be raised increases

in proportion to the difference between the diameters of the driving-wheel and of the small wheel, or pinion, yet the muscular advantage gained nearly counterbalances this increase of weight. A real practical advantage, therefore, resulted from Hughes's invention, although the mechanism employed is unnecessarily complicated, and not judiciously disposed, since by means of it work which could not before be wrought by the machine may now be performed by it.

In order to relieve the weaver still farther by diminishing the weight on the treadle, and thus adapting the machine to heavier patterns and wider silks, Mr. Richards, in 1820, attached to the prolonged axis of the machine, an arm carrying a leaden weight of such a magnitude as to counter-balance that of the lashes. The practical advantage of this contrivance was however diminished by the weight being fixed in an inconvenient situation, and being liable to jar the machine, in consequence of which in March 1821, Mr. Hughes removed it from its original place, and fixed it within the frame on one of the driving-wheels. A still further improvement in its position was subsequently made by Mr. Richards, who has prolonged the axis of the driving-wheel, giving it the form of a quadrilateral prism, and on any part of this axis which local circumstances may point out as most convenient, the counter-weight may be fixed by screws farther from or nearer to the center of motion according to the magnitude of the weight required to be counterpoised.

In order to render the above-mentioned improvement more intelligible not only to the silk weaver, but to the public in general, it has been thought fit to give a representation, showing the connexion of the immediate subject of reward with the whole apparatus for weaving silks as now employed in Spitalfields. The Committee of Correspondence and Papers, were the more readily induced to adopt this measure,

as hitherto no correct representation of the silk loom and draw-boy has been published.

References to the Engraving of a Silk Loom for weaving figured Silk, with Mr. RICHARDS'S *Improvements on the Draw-Boy.* —Plate III.

Fig. 1 represents a cross section of the draw-boy at the dotted line *a a*, fig. 2, with a side view of the loom, &c.

Fig. 2 is a section of the loom at the dotted line *b b* fig. 1, together with a side view of the draw-boy.

Fig. 3 is a plan of the draw-boy, with part of its frame.

Fig. 4 is a longitudinal section of the axle, &c., of the draw-boy.

Fig. 5 is a cross section of the axle of the draw-boy and figure-box.

Figs. 1 and 2 are drawn to a scale of $\frac{3}{4}$ of an inch to a foot, and figs. 3, 4 and 5 to a scale of 2 inches to a foot.

The same letters of reference refer to the same parts in each figure.

A A A, is the frame of the loom, B the roll or beam on which the warp is put, C the cloth or breast roll, D D the lay or bottom, E the reed, F F a frame which supports and regulates the table of mullets; G the table, which consists of a number of thin bars fixed in a frame nearly in a vertical position, but which can be elevated or inclined at pleasure by a hoop H; between each of these thin bars are placed one, two, three, or more small mullets or pulleys *c c c*, over which pass the horizontal strings or tail *d d d*, by which the lambs or headdles I I J J and K K are suspended. To weave plain cloth, only two leaves of headdles are really necessary; but in fine

webs, where many threads are contained in the warp, the number of headdles required in one shaft would be so great that they would be crowded together, which would cause unnecessary friction and strain the warp: for this reason, a greater number of leaves is used in weaving figured silks, &c.; the number of these leaves is so great, that the shafts on which the headdles are placed, are obliged to be arranged in two three or more stages, one above another, as shown in figs. 1 and 2 at I I, J J, K K, so that when the lowest set of headdle shafts I I are raised to make the sheds or opening in the warp through which the shuttle passes, they are in the situation of those at *i i*, and do not rise so high as to interfere with those at J J, and when those at J J are raised to *j j*, they do not interfere with those at K K, and those at K K will be raised to *k k*, so by this arrangement there will be three times the number of the leaves of headdles in nearly the same space as when placed on the same level.

To each of the lower treaddle shafts are suspended three long small leaden weights *l l l*, so as to keep the treaddles straight and perpendicular. The strings *d d d* which suspend the treaddles are extended across the room, and are made fast to a horizontal rod L, which is also fixed by cords to the side of the room; M is a bar or roll which is suspended from the ceiling of the room to support the strings or tail *d d*, &c. N is another roll which is itself supported by a frame from the upper part of the loom, and supports the strings *d d*, &c. when the depression is made on them, by the action of the foot on the treaddles O O, P P, Q Q, from which the motion is communicated to the draw-boy, &c. R R is the frame of the draw-boy, which must be fixed to the floor.

S is a square wooden bar, or axle of the draw-boy, mounted so as to turn backwards and forwards on two screwed centers *e e*, figs. 2, 3, 4, fixed in the ends of the frame R R. There are

also fixed to each end of the frame R R, and concentric to the axis of the screwed centers *e e*, a cylindrical ring *m* and *n*, figs. 3, 4, of brass or iron; one end of each ring is made flat, with an internal flanch for fixing it to the end of the frame, and the other ends of the rings are formed into inclined planes. On the upper side of the axle S are inserted in two parallel grooves, two wooden racks *f* and *g* fig. 3, so as to slide easily backwards and forwards; the upper edges of the racks have teeth similar to those of saws, but the inclined side of the teeth in each rack is in contrary directions; to one end of each rack is fixed a piece of brass *o* and *p*, and rounded off on the end, so as to act smoothly on the circular inclined planes *m* and *n*: beneath the racks are concealed two spiral springs *h h*, the action of which tends to press the brass ends of the racks against the inclined planes *m* and *n*.—T is the draw-boy or bow, seen best in fig. 5, which consists of a semi-circular piece of iron or brass, with a groove in the periphery like a pulley, and each of its ends are divided so as to form cleft hooks, or claws, which clip the strings or lashes above the knots *r r*, so that when the axle S is made to vibrate, the hooks *q q* first draw a lash or string on one side, and then on the other, alternately.

The draw-boy or semi-circle T is fixed on a carriage U, called the figure-box, which slides easily upon the axle S, and has two clicks or catches, *s* and *t*, in the inside of the box, with a string pressing on the upper side of each, and causing the clicks to act on the teeth of the racks *f* and *g*. V is a roller supported by its pivots on the upper side of the carriage U, having the two pins or levers *u* and *v*, fixed in it, opposite to each other, and projecting over the ends of clicks that act on the racks; on the upper side of each click is fixed a hook or staple which connects the clicks to the levers *u* and *v*, so that when the lever *u* is depressed, the click *s* is at liberty to act on the teeth of the rack *f*, and at the same instant the lever *v*

will be raised, and disengage the click *t* from the rack *g*, and when the lever *v* is depressed, the click *t* will be at liberty to act on the teeth of the rack *g*, and the click *s* will be disengaged from the rack *f*, consequently only one of the clicks can act on the racks at the same time. The roller V is kept in either situation, by the action of a spring 1, figs. 3, 4, fixed on the upper side of the figure-box or carriage U, and having a double inclined plane on the under side of it near the point, the middle of which is situated over the pivot in the end of the roller V, and acts on a small pin which is fixed in the end of the roller, and on the upper side, and also over the center of the pivot, when the levers *u* and *v* are horizontal; consequently when the lever *u* is depressed, the pin in the end of the roller will be turned in the same direction, and the inclined plane nearest the point of the spring 1 will retain it in that situation till the lever *v* is depressed, which will cause the pin to raise the spring 3, and pass to the other side of the inclined plane, when it will again be detained till the carriage has arrived at the other end of the axle S. On the under side of the roller V, and at right angles to the levers *u* and *v*, is fixed another pin or lever *w*, which passes through a hole or short slit in the middle of a small bar *x*, which is placed a little below and at right angles to the axis of the roller, and also passes through each end of the box U, and is at liberty to slide backwards and forwards, so that when the box or carriage U has traversed over the number of teeth required in the rack, the end of the bar *x* comes in contact with a spring *y*, (which is fixed on the axle S between the racks) and depresses it till it overcomes the resistance of the bar *x*, &c. which will be thrust forwards, and act on the pin as in the underside of the roller V, and also turn the roller in the same direction as by depressing the lever *v*, which will disengage the click *s*, and engage the click *t* in the rack *g*; then the carriage will

be in proper trim for traversing to the other end of the axle S, which is performed by the action given to the treaddles, which is also communicated to the pulley 2, on the end of the axle S, and therefore causes the axle to vibrate half a turn each motion of the treaddles; as the axle is in the act of turning in the direction of the arrow, the circular inclined plane *n* acts against the end of the rack *g* and pushes it along the groove in the axle S, together with the carriage U, &c. equal to one notch or tooth of the rack; when the axle has returned half way, the spiral spring *h* presses back the rack *g* to its former situation without moving the carriage U on the axle S (as the rack is at liberty to slide in that direction under the click without butting against one of the teeth), and by repeating another vibration of the axle, the carriage will be moved forward another tooth, one tooth each vibration, and so on till the carriage has arrived at the other end of the axle S; then the other end of the bar *x* will be brought in contact and pushed against a spring *z* (which is fixed on the upper side of the axle between the racks at any required distance from the spring *y* between the racks according to the number of strings or lashes *r r* that the figure may require) till the spring overcomes the resistance of the bar *x*, &c. which turns the roller V, and changes the action of the clicks *s* and *t*; then the carriage U will traverse back one tooth for each vibration of the axle S, by the action of the circular inclined plane *m* on the rack *f*, till the end of the bar *x* comes in contact with the spring *y*, when the actions of the clicks *s* and *t* will be again changed.—The racks *f* and *g* both slide backwards and forwards the extent of a tooth, by the action of the two circular inclined planes *m* and *n* for each vibration of the axle; but as only one of the clicks is allowed to act on the rack at the same time, the motion of the other rack does not interrupt the progress of the carriage U, &c. The frame which contains the joint end

of the click *s*, can be so adjusted by the screw 3, that the carriage U will be stopped by each vibration of the axle S, in a situation differing by half a tooth, according as it traverses one way or the other; so that a different set of strings, or lashes *r r*, &c. will be drawn at each vibration of the axle, till the carriage U has traversed backwards and forwards on the axle S. W and X, are two rails of wood fixed on the upper side of the frame R R of the draw-boy, and parallel to the axle S: on the inner edge of the rails are fixed double the number of wire staples 4 4, &c. to that of the teeth in the racks *f* and *g*; the staples 4 4, &c. act as guides to the strings or lashes *r r*, which pass through them, and are fixed to the rail Y, which has four rows of holes through which the strings *r r*, &c. are passed and retained by a knot on the under side of the rail; the number of holes is equal, and opposite to those of the staples 4 4, &c., and is also parallel to the axle S. In the ends of the rails W and X are slits, through which the screws 5 pass that fix them to the frame, so that the staples 4 4, &c. in the rails can be adjusted opposite to the groove in the periphery of the draw-boy: 6 6 are two thin rails, or false tail boards, which are also fixed on the upper side of the frame R R, and parallel to the rails W and X. The strings *r r* being made fast to the rail Y, and passed through their respective staples 4 4, &c. have another set of strings tied to them at 10 10, called the false tails, which are passed over and through guide staples on the upper sides of two smooth round rods or arms 8 8, and then passed through the holes in the rails 6 6, and to the ends of the strings are appended small leaden weights or lingots, 9 9, &c. which draw the strings *r r*, &c. so as always to keep them straight; one end of the rods or arms 8 8 is attached to the upper part of the frame of the loom, and the other ends are suspended by strings from the ceiling of the room; to the upper ends of each of the

strings *r r* at 11 11, is tied another series of smaller strings or lashes 12 12, the upper ends of which are also tied to certain horizontal strings *d d*, &c. which pass over the pulleys in the table G, and have the lambs or headdles suspended from them; by this arrangement it will be seen that when one of the strings *r* which is fastened to the rail Y is pulled down (by the action of the draw-boy or bow on the upper side of the string *r*) it draws one of 10, lifts one of the weight 9, and raises such an arrangement of the lambs or headdles as is proper to produce the figure which is to be woven.

When the draw-boy T and axle S are returned to the situation as shown in fig. 5, the weights *l l l* which are suspended from the lambs, and those at 9 9 will replace the lambs, lashes, &c. in their former situation.

In weaving heavy silks, or what is termed three, four, or more doubles, that is, so many double threads between each split of the reed; the power required to depress the treaddles is so great, that the weaver was obliged to have the assistance of a boy to turn a winch, which was fixed on the end of the axle S which passed through the end frame of the draw-boy.

The application of the winch to the draw-boy was the invention of John Sholl, who was rewarded by the Society of Arts, &c. in the year 1810.

Mr. Richards being a machine or loom-maker, observed the great difficulty of getting boys to attend their work, together with the expense, which caused him to turn his attention to the subject, and he has been successful in making the machine so perfect and powerful as to supersede the necessity of a boy.

The following are Mr. Richards's improvements on the draw-boy:—

The power which is to be applied to the treaddles O O is communicated to the treaddles P P by the cords 13 13, and from the treaddles P P to Q Q by the cords 14 14, and from

the treaddles Q Q to the pulley 2 (which is represented by the dotted circle) by the cords 15 15, which are tied to the treaddles Q Q, and passed over two small guide pullies (the frames of which are fixed to a cross bar of the frame R R); then one of the cords is passed under, and the other over the pulley 2, and fixed to the heads of two screwed nails which are screwed into the grooves in the periphery of the pulley 2; the pulley 2 is fixed to the side of another pulley 18, eccentric to the axis of the axle *s*, by which means the power to turn the axle of the draw-boy increases as the treaddles are depressed.—Z is another axle which turns on two conical steel centers, similar to those which support the axle S; to one end of the axle Z is fixed an iron wire 19, having a slit along it, through which a screw passes for fixing a weight 20, at any required distance from the center of the axle; on the other end of the axle Z is fixed a pulley, 21, perpendicular to the pulley 18 on the axle S, each of which has two grooves on their respective peripheries; 22 and 23 are two cords which are passed round the pullies in contrary directions, the upper ends are fixed to the pulley 18, and the lower to 21; by which means the motion of the axle S is communicated to the axle Z. Now, suppose the treaddles were level with each other, the weight 20 would be perpendicular above the axle Z, and would tend to turn it either way, consequently, as one of the treaddles is depressed, the weight will pass to one side or the other of the axle, and its leverage power will be increased till the center of gravity of the weight 20 has arrived horizontal with the axis of the axle Z; it will be obvious, that either by increasing the weight 20, or extending it further from the axle, the power will be encreased; and by combining the eccentricity of the pulley 2 with the eccentricity of the weight 20, the power applied to the treaddles may be increased so as to counterbalance any number of lambs or headdles, and the weights

appended to them, and to the false tail, together with the power required for raising or opening the warp for the shuttle to pass through.

Another of Mr. Richards's improvements is the application, with certain modifications, of box 24, called the tabby-box, which is fitted to the axle S, and has a semi-circle 25 fixed to it, similar to the figure-box, but without the clicks, &c. To the under part of the box 24 is fixed a wire rod 26, which passes easily through the figure-box and is supported by a staple 27 near the end of the axle, through both of which it is at liberty to slide to and fro.

28 and 29 are two sliding sockets which can be fixed on the wire in any required place by a set screw in the side of each.

The use of the tabby-box is, to raise a certain set of the lambs or headles to work the plain part of the silk between the figures without having so much lash tied to each of the strings *r r*, &c. To adjust the tabby-box for weaving figured cloth with a plain ground, the two sliding sockets 28 and 29, must be fixed on the wire rod 26, in their situations as shown in fig. 4; two strings or lashes must also be fixed in a similar manner as those already described at *r r*, on each side of the axle opposite the tabby-box, and passed through the staples 30 and 31, see fig. 3 (only part of the rails on one side of the axle which the staples are fixed in is shown here, but the other side is fitted up in a similar manner). Suppose the loom was all ready prepared to weave the figure as represented at fig. 6, and to commence at the line 30; the treadles being put in motion, will cause the axle to vibrate, the draw-boy or bow T, on the figure box U, will draw every other string or lash *r r* on each side of the axle S, alternately, till the box U has arrived at the spring Z, and raises such an arrangement of the lambs or headles, as is proper to produce the figures in

the squares 33 33; at the same time the bow or semi-circle 25, on the tabby-box is drawing the strings or lashes 31 31, on each side of the axle alternately, and raises such an arrangement of the lambs, as to produce the plain part of the cloth in the squares 34 34. At the instant the end of the small bar *x* in the figure-box U, comes in contact with the spring *z*, (on the upper side of the axle S) the same end of the figure box on the under side of the axle also comes in contact with the socket 29, and at the next vibration of the axle, the rack *g* will press the figure-box U, together with the tabby-box 24 forward on the axle, equal to one tooth of the rack, when the action of the clicks in the figure-box will be changed, and the bow or semi-circle 25 on the tabby-box will be opposite the staples which contain the strings or lashes 32 32, and will remain there and draw the lashes on each side of the axle alternately, and raise such an arrangement of the lambs as to produce the plain cloth in the squares 35 35, and at the same time the figure-box U will be traversing to the other end of the axle, and the semi-circle T will be drawing the lashes *r r* on each side of the axle alternately, which it skipped when it traversed the other way, by which means a new arrangement of the lambs will be raised, so as to produce the figures in the squares 36 36. When the other end of the small bar *x* shall be brought in contact with the spring *y*, at the same instant the end of the figure-box will be in contact with the socket 28, and the next vibration of the axle will cause the rack *f* to push the figure-box, together with the tabby-box, along the axle S equal to one tooth of the rack; then the tabby-box, together with the wire rod and sockets, will be in their former situations, as shown in fig. 4; and the action of the clicks in the figure-box will again be changed, and the whole figure completed, and the machine ready to produce a similar set of figures to those already described.

N° IV.

IMPROVED RIBBON LOOM.

The GOLD VULCAN MEDAL *and* FIFTY GUINEAS *were this Session given to Mr.* J. THOMPSON *of Coventry, for an* IMPROVEMENT IN THE LOOM FOR WEAVING SILK RIBBONS. *Specimens of Work produced by Mr.* THOMPSON'S LOOM *were laid before the Committee, which, with a Model of the Machine, have been placed in the Repository of the Society.*

IN weaving figured ribbons, the same general process takes place as in weaving figured goods of all kinds: that is, the warp is arranged into two sets of threads which cross each other, but instead of the shuttle which carries the cross thread or shoot, passing at each throw between all the threads which compose the sets, certain of the threads are raised out of the line of the shuttle's passage, which forms that irregularity in the texture of the fabric which constitutes the pattern.

The raising the threads of the warp is effected by passing them through loops in vertical cords, each cord having a leaden weight suspended to it, in order to make it hang perpendicular and move freely, while the other end of the

cord is connected with a lever, worked by a treadle, so that the weaver when pressing on a treadle raises all the cords attached to that lever, together with their threads, and when his foot is taken off the treadle the threads fall down again into their proper place by the gravity of the leaden weights fixed to the ends of the vertical cords.

Hence the natural limit to the fineness and length of the pattern or figure is the utmost number of treadles that can be conveniently managed, and the greatest weight that can be conveniently raised by each treadle. The machinery of the common English ribbon loom is such that, in order to keep the treadles within a reasonable number, and at the same time to allow of a proper length of figure, four threads of the warp are passed through each loop: hence, necessarily results a certain coarseness of work. In Mr. Thompson's machine a cord is appropriated to each thread, it can in consequence produce figures much finer than any heretofore made in this country, and of larger size. The time required for mounting the loom is not greater than usual, regard being had to the nature of the pattern. Eight treadles in Mr. Thompson's engine do the work of thirty two treadles in the common one, and hence the former is less laborious to the weaver in making those patterns that are common to both engines; but the usual one is limited to forty lashes, whereas the improved one extends to 180 lashes, so that it is capable of producing work of greatly superior richness and fineness. The common loom makes only one ribbon at a time, and produces at the rate of about $1\frac{1}{2}$ piece per week; Mr. Thompson's makes four at once, and though the same time is required in piecing threads, removing knots, &c., in one case as in the other, yet the rate of work in the new loom is four pieces per week; another advantage attending it is, that it allows the weaver

to put any quantity of plain work that he pleases between the pattern without changing the figure, by means of which if the loom when mounted for any figure proves too heavy to be conveniently managed by the weaver, the weight may be diminished merely by increasing the relative proportion of plain to figured work. Lastly, the weaver may instantly throw off the figure altogether, and produce plain ribbons whenever work of this kind is required, whereas all the present figure-looms must continue making the particular figure for which they have been mounted.

Reference to the Engravings of Mr. THOMPSON'S *Ribbon Loom.* Plates 4, 5, 6, and 7.

Figures 1 and 2, plate 4, are a side and front elevation of the most improved engine-loom for weaving figured ribbons, as now used at Coventry. The particular invention in question is comprised in the machinery, situated above the rails *a a*. This part, of which a detailed description will be given in references to the three following plates, will be rendered more intelligible by a previous explanation of those other parts of the loom, to the use of which it is made subservient. The framing of the loom is marked with the letters *b b*, &c. on the various rails and posts; *c* is the weaver's seat; *d* the *breast piece*, shown in section at figure 3; *e e* is the *warp*, which being wound on separate rollers *f f*, passes round the roller *g* (extending from one side of the loom to the other), is acted on by the *leashes* or *harness* at *h*, receives the *shoot* from the *shuttles* at *i*, and being now formed into ribbon, passes round a fillet on the upper surface of the breast piece *d*, through a

sloping mortise cut in the same (see fig. 3) and is finally received on to the roller *k*. The warp is kept in a state of tension by cords and weights *l l*, fastened at one end to the rail *o*, and passing round the left hand ends of the rollers *f f*, &c.; these cords and weights are omitted in figure 2 to avoid confusion. The parts *m*, *n n*, *p p*, *q q*, are the *swinging beam*, *swords*, *planks* and *blocks* of the *batten*, the whole of which swings on centers at *r r*, and alternates at every motion of the shuttle, its extreme inclination to the right being nearly as much as it is shown in the engraving to the left. The shuttles have grooves in their upper and under surfaces which receive the thin edges of the planks *p p*, and by which they are retained in their places. The shuttles are impelled by the handle *s*, which moves two rails, one *in* the upper, and the other *on* the lower block *q*; between these two rails, and uniting them together, are four iron *driving teeth*, which have an extent of motion equal to the space between the apertures *t t*, in the planks; the driving teeth striking against the back edges of the shuttles, follow them to the verge of those apertures, and the shuttles proceed quite across by the impetus already given to them. The shuttle carries in a cavity the silk called the *shoot*, viz. that which lies across the ribbon, and is interlaced with the warp which lies lengthwise; the shoot is wound round a small reed, called a *quill*, which runs on a wire axle in the cavity of the shuttle, and to which a certain degree of friction is given by a slight spring; the friction is overcome by the motion of the shuttle, the quill revolves, and enough shoot is given out for the width of the ribbon. The apertures *t t* are occupied by exceedingly fine steel gratings, called *reeds* (from their having been formerly made of split reeds); through these the threads of the warp pass, and by them they are kept separate,

each thread passing through its own opening. That portion of warp which is lifted at *h* by the leashes or harness, takes the position shown by the upper dotted lines, the two portions forming an opening sufficient to allow the free passage of the shuttle. After each *shoot*, as the throwing of the shuttle is called, the batten is drawn forward by the weaver's hand with some force to press *the shoot* close into the intersection of the warp, which it does by means of the reed in the aperture *t*. This motion of the batten has within a few years been made available in winding up the work as it is finished, instead of its being done occasionally by the weaver's hand. For this purpose a small arm *u*, with notches in its upper edge is fixed to the axle *r* of the swinging beam, and from it depends the loaded cord *v v*, passing in its way once round the roller *w*, which receives in consequence at every recession of the batten a certain motion, the quantity of which is determinable by the notch on which the cord *v v* is hung. On the axis of the roller *w* is fixed an endless screw, acting in a toothed wheel fixed on the axis of the roller *k*, which therefore takes up the ribbon as fast as it is made. The transmission of the advancing motion of the batten to the roller *k* is prevented by the friction of a second loaded cord *x x*, which is fastened at the upper end to the framing of the loom, and passes once round the roller *w*, in the same direction as the first.

Before describing the apparatus, which, acting on the warp previous to its receiving the shoot, determines the figure to appear on the surface of the ribbon, it may be useful to state generally, that the figure is produced by bringing different portions of the warp above the surface at every shoot. All the fibres of the warp pass through distinct loops or *eyes* in as many upright threads, called the

leashes or *harness*, shown in the engraving at 1 1, to each of which is hung a long thin leaden weight, called a *lingo* 2, 2; the leashes or harness to each of the four ribbons are at the parts 1 1, arranged in a mass in the form of a parallelogram, in consequence of their passing through holes, disposed in that manner in a board 3, 3, called the compass board, which has a notch cut in it for each harness; the notch is filled in with a piece of thin hard wood, in which the perforations are made for the leashes; a section of the board at this part is shown in fig. 4. The harness after passing through the compass board upwards, branches into different directions to suit the nature of the action it is to receive from the machinery above. If, for instance, the ribbon is to have a figure in the middle only, the sides being plain (as we have supposed in the present case, and as the engravings describe it) the outer portions of the harness containing that part of the warp destined for the edges of the ribbon is separated from the rest, and attached to cords 4, 4, which are connected with the machinery above, in a manner which will be hereafter described. These cords are necessarily omitted in the side view, as they would each of them be repeated sixteen times. The harness next passes through holes arranged in two rows in the *leash board* 5, 5, and the threads are so disposed in this board, that the situation of each, with respect to the warp, is easily known by counting; that is to say, it is easily known in what part of the ribbon that fibre of warp lies, which will be acted on by any particular thread of the harness. Immediately above the leash board 5, 5, are seen knots; at these knots every thread of the harness branches out into four slight lines, each passing through a different row of holes in the *lash* board 14, 14. We have said that from the knots above the leash board

5, 5, each thread branches out into four; this is not strictly the case; because as the harness of two similar patterns meet in the board 5, 5, two threads pass through each hole, the two being of course those which apply to the same part of the figure in the two ribbons, and each of these pairs being knotted together, are connected with the four slight lines above-mentioned. We must now re-commence from the top, and trace the connection of the machinery and its dependent apparatus downwards till we meet the leash board 5, 5.

There are sixty four cords, 6, 6, &c. four shewn in the front view and sixteen in the side; each of these cords is raised in succession, and in the particular machinery for doing this is comprised the whole of the present invention, all the other parts of the loom being such as are in general use. Sixteen treadles 7, 7, depress successively, each of sixteen levers, called *lambs* 8, 8, hung on small iron axles, fixed in uprights, attached to the framing of the loom. The left foot treadles are connected by cords 9, 9, &c. with the upper tier of lambs, and the right foot treadles by similar cords 10, 10, &c. to the lower tier. From each lamb ascends a cord 12 12, branching into two at the upper end, and connected with the inner extremities of the tumblers A, of which there are thirty two (sixteen on each side). The sixteen *treadle cords* 12 12, &c. are omitted in figure 1, and being arranged in a straight line, only one can be seen in figure 2; it is for the purpose of their thus forming a straight line that the lambs are interposed between them and the treadles. Each of the tumblers A is moved in succession by the treadles respecting which it may be observed, that the weaver begins with one of those at the outside, next takes the other outside, then those respectively within the first and

second, and so on till his feet meet in the center; after which he again re-commences from the extremes.

Sixteen or twenty treadles are as many as can be conveniently and effectually worked, but a pattern or figure of moderate length requires from sixty to one hundred and twenty different shoots, it is necessary, therefore, to convert the sixteen or twenty movements obtained by the treadles into sixty or one hundred and twenty different actions on the harness. Some persons have accomplished this by an application of the *draw-boy* rewarded many years since by the society, and an improvement on which is described in the present volume. This application, however, besides being the subject of a patent, is destitute of several advantages belonging to the present invention, which is shown on a larger scale in the plates 5, 6, and 7. In these engravings it will be observed, that not merely are the same parts in the different plates referred to by the same letter, but where there are two or more similar parts they are denoted by the same letters and are individually distinguished by an added figure.

Plate V is a bird's-eye view of the apparatus: figure 1 of Plate VI. is a side elevation; and Plate VII. is one half of it front elevation, and the other half a vertical section through the dotted lines Z Z Z in figure 1, Plate VI. In all these A1, A2, &c. are thirty-two *tumblers* moveable on axles at their centers, by means of the treadle cords 12 12, &c., attached to their inner extremities; at their outer extremities they are connected by similar cords to the sixteen *lifting shafts* B 1 B2, &c., from which depend (by cords shown in the sectional half of Plate VII.) thirty-two *lifting irons* C C, &c.; D D, &c. are eight upright posts, each having a groove in its inner face for the following purpose. It is necessary that ribs of wood V V &c. should

be placed to guide the ascent and descent of the lifting irons C C; but if these ribs were fixed in the situation shown in plate 6, they would prevent the convenient access to such parts of the apparatus as lie behind them; they are placed, therefore, in four frames U U &c. two of which are shown in section in Plate 7; the sides of these frames are rebated down to fit, and to slide in the grooves in the posts D D; they are retained in their places by small metal pins, which being withdrawn, they slide down and expose the machinery in the upper half of the apparatus. E E &c. are the two top horizontal rails of the same form and size as the lifting shafts B B, but somewhat thicker; F F are rails framed between the posts, and the whole is held together by transverse rails G G, &c. of which, part only are shown in the engravings. H H &c, are four uprights supporting the axles of the tumblers, and I I are four similar uprights supporting two iron wires nearly like the axles of the tumblers, and on which the outer ends of the tumblers rest when not in action. These wires are omitted in the engravings. On the top of the rails F F are placed small friction rollers, two rails having five each, and two having four; on these friction rollers lie the nine *tier shafts* K 1 K 2 &c. The hinder ends of the tier shafts are united together by cords passing round pulleys in the racks L L in such manner that K 1 is connected with K 6; K 2 with K 7; K 3 with K 8, and K 4 with K 9; K 5 has a loaded cord at its hinder extremity passing round the wheel M, and having a constant tendency to draw it backward against the rail N; see an elevation of the pulley and weight in figure 2. The *fore* ends of the shafts K 6, 7, 8 and 9 have similar loaded cords passing round four wheels which keep a continual pull on the respective shafts, tending to draw K 6, 7, 8 and 9 forward, and of conse-

quence to draw K 1, 2, 3 and 4 backward. Fig. 3 is an elevation of one of the wheels with the cord and weight attached to the fore end of the tier shaft. To each tier shaft except K 5, are hung by cords called *tug cords*, sixteen *tier irons*, P P, &c., and to the shaft K 5 is hung one such tier iron. The situations of the sixty-five tier irons in the left hand half of the apparatus are described in the sectional plan, fig. 3, Plate 6, in which they are seen arranged in rows under the tier shafts, whose places are indicated by dotted lines. One row of the irons will be seen to be advanced a little to the right hand, and the letters P P &c. referring to that row in the elevation are placed in a line below the other range of letters P P &c. The shape of the tier irons with the hook or catch in their upper ends, and the manner of hanging them to the tier shafts by the tug cords are described in figure 2. Leaving for the present the single tier iron on K 5, out of the question, there are sixty-four in each half of the apparatus to all of which are attached cords 6 6 &c. These cords acting on the harness or leashes by means of the lash 13, 13, separate the warp in sixty-four different proportions at the time the shoot passes through it, and produce a figure equal in length to the space occupied by sixty-four shoots. Here it may be noticed that the machinery for accomplishing this, and which is shown in plates 5, 6, and 7, consists of two parts, precisely similar to each other in their mode of action, and in the nature of their connection with the loom ; the only circumstance in which they differ is, that to the left hand half are attached the means for effecting some changes in the internal parts, which changes are transmitted to the right hand half by the connecting cords attached to the tier shafts already described. The internal changes alluded to consist in so altering at certain periods

the dispositions of particular parts, that in depressing the sixteen treadles four times, sixty-four different tier irons may be lifted. We have already shown that the tier irons are disposed in rows each equal in number to the number of treadles; a reference to figure 2, plate 6, will show how the irons in any one row may all be raised in succession; it will be seen that those attached to K 1, are hanging with their back edges in contact with the lifting irons C C &c., but when the tier shaft is drawn forward as K 3 is described to be, the hooks of the tier irons are brought immediately over the lifting irons, and the latter evidently cannot be lifted without the former, in the manner one of them is shown to be, with its tug cord slackened; the dotted lines in plate 7, describe the positions of the tumblers, lifting shafts, and lifting irons, at each elevation; and the sectional plan fig. 3 plate 6, shows the sixteen tier irons, of the shaft K 3 with their hooks drawn over the lifting irons; it will not therefore be difficult to conceive how each of these sixteen may be lifted in succession by successive depressions of the treadles, nor how the sixteen in the other half of the apparatus, which are suspended from the tier-shaft, in connection with K 3 may also be lifted at the same time, with this consideration that as the motion of K 3 is forward, while that of K 8, in connection with it is backward, the hooks of the tier irons in the two halves of the apparatus will stand in different directions, those in the left hand pointing forward, those in the right, backward. All then that is required is to draw on each pair of tier shafts in succession, and after each of the four pair has been brought into action, and of consequence the figure has been completed, to produce an arrangement which shall suspend the recommencement of the figure, till a length of ribbon determinable at will shall

have been made plain. For all this it will be seen, that the machinery has resources within itself; in the first place the foremost ends of the tier shafts K 1, 2, 3, 4 and 5, are connected by cords, with the upper ends of five *tier tumblers*, Q 1, 2, 3, 4 and 5, which are hung by their centers on a common axle. A falling flap R swings in two brackets fixed to the posts D D, and by falling retains the upper end of any of the tier tumblers Q which shall have been drawn from under it, as is the case in the engravings with Q 3, in consequence of which the tier shaft K 3 is drawn forward, and K 8 backward, carrying with them the tier irons suspended from them, which are now situated with respect to the lifting irons as has already been explained by figure 2 of plate 6; the quantity of motion given to the tier shafts is more than can be communicated to the tier irons, in consequence of the closeness of the lifting irons, the tug cords therefore are drawn into a sloping direction, which ensures the close contact of the tier irons with the lifting irons, and it is an advantage if the irons be so suspended that on the return of the shaft, the inclination of the tug cords be a little in the other direction, which would equally secure the tier irons from coming into action at improper periods.

Let it be supposed that the weaver beginning to work has drawn on the irons suspended from K 1 and K 6, that they have been all lifted; that those suspended from K 2 and K 7 have also been drawn on, and successively lifted, that now those of K 3 and K 8 are on, and that fifteen of the irons have been lifted, the foremost one only remaining; observe now by reference to plate 6 that the foremost iron of each row, has, besides the cord hanging perpendicularly from it, a second cord which passes under the roller S, and is fastened to

the lower end of one of the tier tumblers Q; observe farther, by reference to the sectional plan, figure 3, in the same plate that the additional cord attached to the foremost iron of the shaft K 1 is not connected with the tier tumbler Q 1, but with Q 2; the iron of K 2 with Q 3, and so on; when therefore, the foremost iron is lifted, at the same time that it performs its office with respect to the lash and harness, it brings by means of its secondary cord forcing outward the upper end of the tier tumbler, another pair of tier shafts, and two other rows of tier irons into action, the weaver at the next shoot recommencing with the first treadle; K 4 and K 9, may now be supposed in action, and after their irons have been lifted, the foremost one of K 4, will by its secondary cord have drawn on the shaft K 5, whose single iron has no cord acting on the lash or harness, but has one which passes under the roller S, round the two small pulleys T T, and is fastened to the lower end of the tier tumbler Q 1; so long as the shaft K 5 (which having no tier irons may be called a *blank shaft)* is on, the plain part of the ribbon is made by the cords 4 4, which are attached to the lifting irons, and which move, therefore, independently of the tier irons, the lash, or the harness.

Where, however, a plain interval is made between the figures it is generally in satin ribbons, and is produced by means which will be presently described. The cords 4 4, are attached to bundles of leash as the engraving represents them, only when the figure occupies the whole of the middle of the ribbon, and is bounded on each side by straight lines as in the two left hand ribbons; the two right hand ones have distinct figured spots, and are supposed to be satin ribbons. The two sorts, though for the sake of explanation they are in the engraving put into one

loom are never wove together. The blank shaft would not be required for such ribbons as the two left hand or sarsenet ones; for these it would be required only to attach the cord which passes round the pulleys T T to the fourth tier shaft, which would draw on the first, and re-commence the figure without an interval.

If sixteen shoots of plain, are required between the figures of a satin ribbon, one such shaft as K 5 is wanted, if thirty two shoots of plain are required there must be two such shafts; if there be more than one blank shaft, the second must be brought on by the first, and the third by the second, in the same manner as has been described for those K 1, 2, &c.; and the last only will have a cord passing round the rollers T T; whether, however, there be one or more blank shafts, it will be evident by inspecting the figure and tracing the operation of the cord passing round the rollers T T, that when enough plain ribbon has been made, the tier tumbler Q 1 will be drawn inward at bottom, consequently outward at top, and with it the tier shafts K 1 and K 6, which will recommence the figures. It is, perhaps, scarcely necessary to mention that when one tier tumbler is drawn from under the flap R, that which had previously been out falls back again; to facilitate this, and to prevent the friction of the end of the tumbler against the flap from offering any impediment, the upper ends of the tumblers are made not quite square, and they are capped with a piece of wood, the *grain* lying in a different direction, as shown in fig. 4 of Plate 6. The cord of the tier tumbler in use is always slackened as that of Q 3 is represented in figs. 1 and 3.

Having now given motion to the tier irons, it remains to trace downwards their action on the lash and harness, which will be done with reference to one half of the loom

only, as both sides are essentially alike. At the lower end of each tier iron is a cord suspended by a hook; there will, therefore, be sixty four of these cords distinguished by the figs. 6, 6, &c. In putting the figure to work, the weaver by reference to the draught or design of the figure, first ascertains how many threads of the warp must be elevated at the first shoot in the figure; he then attaches so many different threads to the cord of the first tier iron; he next proceeds to the second line of the draught, and to the second iron fastens as many threads as are shown to be necessary, and so on till to each tier iron is affixed the requisite number of threads; these threads are called the lash, and are numbered 13, 13 in Plate 4. It was before said that the threads of the harness are so arranged in passing through the leash board 5, 5, that it may be known which fibre of the warp will be lifted by any one of them. The weaver, therefore, having the requisite number of threads to each tier iron, proceeds to connect them with their respective portions of the warp, which causes them to diverge in the manner described in the Plate 4, fig. 1; in fig. 2 it will be seen that they exhibit no divergence of this kind, but descend in four almost straight lines, because the lash of each row of tier irons passes through its appropriated row of holes in the lash board 14, 14; each row of lash is connected with every portion of the harness by slight lines seen between the boards 5, 5 and 14, 14; two such lines are attached to each knot of the lash, and after passing through the board 14, 14 they spread and are united to the two rows of leash.

So far we had traced the operation of the harness upward; if the process be not understood, it will perhaps be rendered intelligible by a brief recapitulation with two or three additional explanatory circumstances. In the first

place, observe, that the pattern we have supposed to be making is a uniform one; that is to say, it consists of two similar parts which may be divided by a line drawn along the middle of the ribbon, so that when any one portion of the warp is lifted, it is evident that the portion similarly situated in the other half of the ribbon must be lifted also; for which reason there are two rows of holes in the leash board 5, 5; and as one-half of the loom, and of the machinery above, makes two ribbons, through each of these holes pass two threads of leash, making four similar threads in each half of the loom which are lifted at every shoot: supposing, therefore, that there are five threads of lash to be lifted at any one shoot, ten threads of leash would be lifted in each of the two ribbons made by that lash. Let it be recollected that by means of the four slight lines springing from each knot above the leash board 5, 5, either of the four rows of lash above the board 14, 14 can act upon any thread of the harness without interfering with the connexion between that thread and the other three rows. In fig. 5, the part between the two boards is shown separately to explain this; one knot of the threads 13, 13 is raised, lifting with it by means of its two slight lines, the two knots above the lash board 5, while the other six threads proceeding from those two knots become slack, but are tightened again, as soon as the treadle ascends by the weight of the lingoes 2, 2, suspended from each thread of the harness or leash 1, 1; of these threads, there are as many as there are in the warp, and each has a loop or eye through which one fibre of the warp passes, and by which it is lifted; after passing through the compass board 3, 3, the leash of each ribbon divides into four portions; the outer ones attaching themselves to the cords 4, 4 to form the plain

edges, and the duplicate threads of the middle or figured part separating from each other, and passing through the two rows of holes in the leash board 5, 5. As the leashes of two ribbons pass through one leash board in the manner described, there will of course be two threads in each hole of the board united in the knot above, and as two knots are lifted, four threads of leash will be lifted, by each *(lower)* knot of the lash 13, 13. Of the lash it may be observed, that it is attached to knots both at its upper and lower end; one only of the upper knots as has already been shown, is lifted at a time, but this one by the diverging of the threads will lift several of the lower knots; and farther any one of the lower knots may be, and is lifted by several of the upper knots. The number of the lower knots which will be lifted by any one iron is regulated by the number of diverging threads fastened to the cord suspended from that iron; on reference to fig. 1, Plate 4, it will be seen, that to the first cord are attached two threads; to the second, four; to the third, two; to the fourth, three; which lift respectively eight, sixteen, eight, and twelve threads of warp. These numbers are very much smaller than those which actually occur, but it would have been impossible to exhibit on any moderate scale, every thread and cord used in a machine of this kind, and this circumstance must apologize for several slight liberties which have been taken to reduce the number of lines, and to make their arrangement and connexion more intelligible; in the leash board 5, 5 for example, it will be evident from the description that there should have been as many holes in each of the two rows as there are threads of warp in the width of the figure, but not half of that number are drawn; the lash 13, 13 would consist probably of more than a thousand threads;

of this number a very small proportion is shown; the cords and lash depending from that row of tier irons which is drawn forward are omitted altogether, because they would appear in the intervals between the other cords and lash and would make the whole a mass of confusion; further it will have been observed that no supports are shown to the lash boards or compass board; these are either carried on slight wooden bearers attached to the framing of the loom or suspended in their places by cords. The four rows of tier irons are kept apart by narrow slips of wood called *guide stripes* running lengthwise from front to back of the apparatus; and the cords hanging from the tier irons pass through holes in boards lying on the rails *a a;* one of these boards is seen in fig. 1, plate 4, but in all the other engravings they are omitted.

There are some parts of the loom, which having no peculiar or immediate connection with the particular invention in question have not yet been alluded to, but which may now be noticed to render the description complete. In the first place, the means for giving a *pearl edge* (as it is called) to the ribbon, which is formed by portions of the shoot projecting various lengths beyond the edge of the ribbon, and those lengths so governed that the projections shall assume a symmetrical appearance, either as *vandykes* or *scallops*, or other more or less regular figures; this effect is produced in the following manner. Ten or twenty horse hairs are laid along each edge of that part of the warp which lies horizontally, and the several hairs pass through leashes in the same manner, so that, if permanently wove in, the edges of the ribbon would differ from the middle by having its warp of hair instead of silk; but the horse hairs (marked *y* in the engraving) are fastened at the hinder ends to the rail O, and consequently

are drawn out of the ribbon as fast as it is wound on the roller *k*; the hairs are so connected with the leashes, and these again with the machinery above, that in the first shoot, perhaps two hairs on a side are lifted; in the second, four; in the third, six; in the fourth, eight; then six, four, and two successively; after which no hairs are lifted for a few shoots, and the edge is made plain a certain length till the hairs are again acted on. This would produce the simplest sort of pearl edge; but it is necessary to modify this explanation, which for the sake of making it general and intelligible, has been suffered to deviate a little from the fact. Let the two lines *a a*, fig. 5, Plate 6, express the edges of a ribbon, and the lines at right angles the shoot projecting and forming a pearl edge, such as has been described; let the figures signify the number of hairs which were included in the several loops of the shoot to form the pearl edge; it will in the first place be observed, that the shoot must pass from right to left and from left to right to embrace the hairs and to form one loop; and that, therefore, considering but one side of the ribbon, the hairs will require to be acted on only at every second shoot; but it will be further seen that the 8 on one edge is necessarily, not exactly opposite the 8 of the other, but between the 8 and 6 of that other, and that the hairs of one edge will, of consequence, be acted on at one shoot, those of the other at the next, so that an action will take place on the hairs at every shoot, but on one side of the ribbon only; and that action will be alternately on one side and the other. In fig. 2, Plate 4, Z are weights which hang by rings on the hairs and bring them down, after having been raised by the harness to the height shown by the lower dotted lines.

The finished ribbon is not wound immediately on to the

roller K, but on to a thin iron cylinder longer than the width of the ribbon which nearly fits the roller. This cylinder is rendered necessary, because some one of the ribbons, either in consequence of a different thickness of the shoot or of being struck closer by the reeds in the batten, may probably make faster or slower than the others; and as the motion of the roller is common to them all, and must be adapted to the slowest, some means are necessary for preserving the making part of all the ribbons in nearly a straight line, that each may receive the blow from the reeds in the batten; for this purpose, therefore, the cylinders are used, any one of which can be moved round by hand independently of the others, and each is retained in its place by an iron catch or stub, received into one edge of the cylinder, which has serrated teeth for that purpose.

In the description of the loom hitherto, we have supposed for the most part that a sarsenet ribbon has been making; a satin ribbon is made in a manner somewhat different. The peculiar face of satin is given by keeping seven eighths of the warp *floating*, that is above the shoot; if, therefore, satin were made with the face upwards, seven-eighths of the warp must be lifted at every shoot, which would be attended with considerable difficulty and labour; to avoid this, satins whether plain or figured, are made with the face downwards, rendering it necessary, as far as the plain part is concerned, to lift only every eighth thread of the warp at each shoot. The leashes, therefore, through which the warp of a satin ribbon passes, are hung to eight slight wooden laths, called the *satin shafts*, which lie in the loom under, and parallel to, the compass board, as shown in the section fig. 5, Plate 4. Each shaft sustains one-eighth of the whole warp, and in such a loom as we have

been describing these shafts are attached to the lifting irons C C by the cords 4, 4, which will not in this case be fastened to bundles of leash as the engraving represents them. The connexion of the satin shafts with the lifting irons is such that each rises in succession; and as there are sixteen lifting irons, and eight satin shafts, it is necessary for this purpose, merely to attach the first shaft to the lifting irons 1 and 9, the second to the irons 2 and 10, and so on; thus each shaft would be lifted twice in going through all the treadles; by this means a plain satin ribbon would be made. In order to introduce a figure, and leave a part near each edge plain, threads must be fastened below the satin shafts to such of the leashes as hold the warp which will fall within the figure; these threads are merely a continuation of the leashes, and being united below the shafts any number of the leashes required by the figure can be lifted without lifting the shafts from which they hang; the connexion with the tier irons is made as before described, and in the intervals between the figure, if any occur, the shafts only are in action, and form a plain ribbon.

Although we have drawn and described the making of a pattern containing only sixty-four shoots, ribbons are now frequently made by this machinery having one hundred and sixty shoots in the figure, a height of improvement which a very few years since was not contemplated; and which has raised the manufactures of Coventry to at least a level with those of France. It is almost needless to suggest that as the number of shoots is the product of the number of tier shafts, and of the number of tier irons on each, the length of the figure may be varied at will by altering either of those numbers; but as the number of tier irons on one shaft, is equal to

the number of treadles, and as sixteen treadles are as many as can be conveniently and effectually worked, as moreover the number sixteen admits most easily of being applied to the eight satin shafts, an increase had better be made by adding to the number of tier shafts, ten of which would give one hundred and sixty shoots, the increased number requiring nothing more for throwing them on in succession, and re-commencing with the first, than an equal number of tier tumblers with an additional one for each blank shaft, with cords and pulleys arranged as has been already described. The leashes in this case, after passing through the leash board 5, 5 would require to be branched out into ten threads to meet the ten rows of lash which would descend from the tier irons.

Beside these facilities of extension, this apparatus possesses several peculiar advantages, among which is the ease with which the whole or any part can be thrown in or out of gear, by means of small cords descending from each of the tier tumblers to within reach of the weaver, by which he can throw on at pleasure any particular part of the figure, and recur to it after a complete disarrangement of the whole machine. Another advantage is, the complete independence of all the different parts which prevents the derangement of one from affecting the rest, and affords opportunity for easy reparation; to which may be added the great simplicity of the parts which being divested of springs, and of every species of delicate machinery are not liable to be easily affected by use violence or dust.

The only objection, if it may be called one, to which this loom is exposed arises from its height, which cannot be much less than eleven feet, and which in some works would require to be thirteen or fourteen. The engraving represents one of a medium height for making four

ribbons; if eight or ten ribbons are making, the leashes in passing downwards through the leash board 5, 5, having to spread wider, make a smaller angle, and occasion a great deal of friction and wear in the threads against the edges of the holes in the board; this must be prevented by making the distance between the compass board and leash board as large as possible. If, on the other hand, the figure be very extensive, a greater height is required for the increased quantity of lash, which may be regulated by the holes in the two upper standards *b b*.

The figures in plates 5, 6, and 7, are about one-fifth of the real size.

N° V.

NEW MATERIAL FOR STRAW PLAT.

The Large SILVER MEDAL *and* TWENTY GUINEAS, *were this Session given to Miss* SOPHIA WOODHOUSE *(Mrs.* WELLS*), of Weathersfield, in Connecticut, United States, for a* NEW MATERIAL FOR STRAW PLAT. *Samples of the Grass in its raw, bleached, and manufactured State, have been deposited in the Repository of the Society.*

DURING the late war the importation of hats and similar articles for female wear, manufactured of the fine

straw grown for this purpose, and known in the market by the name of Leghorn plat, was almost entirely put a stop to. The consequence of this was, an extraordinary degree of encouragement to our domestic manufacture of plaited straw, and a proportional degree of ease and comfort hence derived, by the agricultural labourers of Bedfordshire, Hertfordshire, and Buckinghamshire, by the wives and children of whom this profitable occupation was chiefly engrossed. Competition naturally led to an improvement of the fabric by splitting the straw, which had heretofore been used entire, and by more accurate selection of the straw itself, and more effectual methods of bleaching. At the conclusion, however, of the war, the trade of the country fell into its usual channels, and bonnets and hats of genuine Leghorn plat soon found their way into our markets. The Leghorn straw being much slenderer than that of English growth, may be employed entire for the finest articles, on which account the plat is rendered more even, pliable, and durable, than that of equal fineness made from split straw: it is also greatly superior in colour. A farther advantage is, that the spiral coil of Leghorn plat of which a hat or bonnet is formed, admits of being joined by knitting the adjacent edges together instead of overlapping and sewing them, as must necessarily be the case with the English plat: on account of which difference of construction, the Italian bonnets and hats are of the same uniform thickness, whereas, the English are an unpleasant alternation of ridges and depressions, and require, besides, a considerably greater quantity of plat. These real grounds of preference, independently of the caprice of fashion, soon began to operate unfavourably on the English straw plat, and in a short time put an end to it as far as regards the finer fabrics.

Another cause also, has operated in producing the present depression of this manufacture, namely, the greater cheapness of labour on the continent in comparison with England. The best Hertfordshire straw may be, and actually is, sent to Switzerland, where it is platted, is then returned to England, paying an import duty of 17 shillings per lb., and may after all, be sold about 25 per cent cheaper than plat made in this country.

Such being the state of things, the Society received with much pleasure a communication from Miss Sophia Woodhouse, the daughter of a farmer residing at Weathersfield, in the State of Connecticut, stating that she had manufactured some bonnets in imitation of Leghorn, from the stems of a species of grass growing spontaneously in that part of the United States, and popularly known by the name of *Ticklemoth*. The communication was accompanied by a bonnet of her manufacture, and a few dried specimens of the entire grass. The bonnet being submitted to the inspection of the principal dealers in such articles, was declared by all of them to be superior even to Leghorn in the fineness of the material and the beauty of its colour; and that the introduction of the straw to this country either by importation or by growing it here, would probably be of public advantage, by supplying a raw material superior to any other, and which probably may be manufactured to great advantage in those parts of Great Britain and Ireland where labour is cheap.

The reward mentioned at the head of this article was, in consequence, voted to Miss Woodhouse, on conditions which should put the Society in possession of some seed of the grass, and also of the process employed by the candidate to bleach the straw. Both these conditions have

been complied with; the seed received has been distributed during the Summer of the present year to various persons in Great Britain and Ireland, and has germinated very successfully, both under cover and in the open air. In the latter situation it has thrown up a thick mat of long and fine herbage, but has not flowered, it is therefore, probably perennial; and if it endures our Winters, will in all likelihood prove a valuable pasture grass.

The treatment of the stems for the purpose of manufacture, is thus described in the words of Miss Woodhouse herself:—

Weathersfield, Connecticut, December 20th, 1821.

I REGRET that the proper season for cutting the grass had elapsed before I received the communication from London. The small quantity which I had previously gathered, I transmit herewith to the Society. Part of it is prepared for plaiting. It may be considered as a specimen of the usual fineness of the grass, as it has not had a straw, coarse or fine, selected from it.

I am able to give no account of the method of cultivation, having never known it cultivated in this country. It grows spontaneously and abundantly in our meadows. It is more common in fields that have not been highly manured, but that are rather reduced in strength and richness of soil; in a few fields it has been observed, that gypsum and manure have destroyed this grass and introduced clover.

I am able to procure but little of the seed. As it has never been sown in this country, very little of it has been preserved.

I have prepared it for manufacture in the following manner:—I have cut it in the fields from the time of its

flowering, until the seed is nearly matured; that part only is used, which is between the upper joint and the top or panicle; on this I pour boiling water and then dry it in the Sun; this operation I repeat once or twice, or until the leaves which sheath the stem come off. I then bleach it, but for this purpose I have used no other apparatus than what every farmer's house furnishes. In the first place, I prepare some soap and water, in which I dissolve pearl-ash until it can be tasted; in this solution I moisten the grass, and then set it in an upright position in the bottom of a cask; I then burn brimstone in the cask by means of a small heated kettle or dish of coals, and close the cask at the top with blankets so as to confine the smoke. This fumigation I continue until the grass, moistened by the solution of pearl-ash, &c., becomes dry, which will require about two hours. During this operation, the kettle will generally require to be re-heated, or the coals to be replenished once or twice. The grass is now ready for platting. After this is performed and the bonnet is sewed together, I fumigate it again with brimstone in the same manner as before, being careful to place the bonnet in a situation in which it will be penetrated by the smoke; the bonnet is now finished by pressing, for which purpose, I have used only a common smoothing-iron. The only caution necessary in this operation is, not to have the iron heated so much as to scorch the grass.

SOPHIA WELLS.

CERTIFICATE.

Hartford County, Connecticut, Weathersfield,
December 27th, A.D. 1821.

PERSONALLY appeared Mrs. Sophia Wells (formerly Miss Sophia Woodhouse), and made solemn oath before me, that she is the inventress of the art of manufacturing hats or bonnets from a certain species of grass, a specimen and description of which accompany this certificate, and the mode of manufacturing is hereto prefixed.

ELIJAH KEACH, *Justice of Peace.*

N° VI.

LEGHORN PLAT.

The Large SILVER MEDAL *was this Session given to Mr.* JOHN PARRY, *Little Mitchell Street, Bartholomew Square,* FOR THE MANUFACTURE OF LEGHORN PLAT FROM STRAW IMPORTED FROM ITALY. *Specimens of the Straw and of the Plat made therefrom, have been placed in the Society's Repository.*

FOR the protection of our domestic manufacture of platted straw, and to encourage at the same time the im-

portation of the raw material (the Italian straw being much fitter for the purpose than that grown in England), the legislature has imposed the duty of 3*l.* per dozen on imported hats, a lighter duty of 17 shillings a lb. on the plat not made up, and a still smaller one of 5 per cent *ad valorem* on the straw. In consequence of this, Mr. Bigg, a straw manufacturer, imported some time ago a considerable quantity of prepared straw from Leghorn, with a view of attempting its manufacture in this country, but not succeeding to his wish, he placed the straw in the hands of Mr. Parry. Mr. Parry began by acquiring, himself, the art of platting according to the Leghorn method, he then taught it to other persons with such success, that he has now above seventy people, women and children, constantly employed in the manufacture. For these spirited and successful exertions, the Society conferred on Mr. Parry the honorary medal above mentioned, on condition of his disclosing to the Society the particulars of the mode of plaiting according to the Italian method. This they did in order that by giving the same a place in their Transactions, they might communicate them generally to those interested in obtaining employment for the poor in the agricultural districts, by contributing to the revival and improvement of a manufacture at once healthful and domestic, and particularly valuable as accustoming children to habits of industry without the imposition of any hurtful degree of bodily labour.

The following is Mr. Parry's communication:—

Mitchell Street, Bartholomew Square,
March 18th, 1822.

SIR;

AGREEABLY with the conditions of the Society of Arts, as contained in your letter of the 22nd ult., I have

sent a sample of the Italian straw as imported; and a specimen of the same made into plat in Great Britain. And as a proof that such plat will answer for the same purposes as the foreign productions, I have sent another piece, equally as well *knitted* together, and in the same manner as such articles are made, as are commonly described by " Leghorn hats."

The process is, to cut the ears off the straw with a knife, and to size (sort or select) them as to length and thickness. To cut off a sufficient proportion of the red and white ends, so as to preserve as much as possible, an uniformity of colour. To take thirteen straws and tie them together at one end, then to divide them into a right angle, placing six straws on the left side, and seven on the right. The seventh or outermost on the right, is to be turned down by the finger and thumb of the right hand, and brought up under two straws, over two, and under two, and seven straws will then be placed on the left side of the angle. Then the finger and thumb of the left hand is to turn down the seventh, or outermost straw on the left side, and to bring it up under two straws, over two, and under two, and seven straws will again be placed on the right side of the angle, and so on alternately, doubling and platting the outermost seventh straw from side to side, until it becomes too short to cross over so as to double on the other side of the angle :—then to take another straw, and put it under the short end, at the point of the angle (middle of the plat); and by another straw coming under and over the joined one, from both sides of the angle in the operation of platting, it will become fastened; the short end being then left out underneath the plat, and the newly fastened straw taking its place on that side of the angle to which the short one was directed : and so continue, repeating the

joining, doubling and platting, until a piece of twenty yards long (more or less), is completed. See fig. 5, Plate XXIV.

The short ends which are left out in the act of joining, are to be cut off with scissors, and the article will be then the same as the specimen herewith sent for the use of the public.

I am, Sir,

A. Aikin, Esq. &c. &c. &c.

Sec. &c. &c. JOHN PARRY.

SUPPLEMENT.

MR. PARRY'S communication relates merely to the manufacture of the straw into plat, but, as the method of knitting or sewing the straw together, according to the Italian mode, is not generally known, the Society instituted an inquiry into this particular.

This part of the business is done principally by Italian jewesses resident in London; and is described in the following figures, Plate XXIV:—

Fig. 5 is a piece of plat of twice the real size, showing the way in which the plat itself is formed.

Fig. 6 represents two portions of plat four times the real size, partly knitted together, showing how the edges of one, fold over the edges of the other, and produce a continuation of the same interrupted line that characterizes the plat itself, so that the junction is imperceptible on either side; the uniting thread being in every part covered by two loops of straw, whereas, at *t* and *v*, it is covered only by a single loop.

Fig. 7 shows two pieces that are knitted, but have been subsequently drawn a little asunder, in order to show more clearly the passage of the thread. It is first inserted under the straw 1, then under straws 2, 3, 4, &c., till it comes out at the top of 10.

Fig. 8 shows two pieces of plat of the real size, with the needle in the act of passing through the folds in the edge of each piece alternately, as above described. The needle is pushed on through two or three folds at once, till nearly the whole of it is concealed in the folds, it is then drawn through in the manner of a bodkin, leaving its place to be taken by the thread. If the edges are not thrust sufficiently close, the needle will miss some of the folds and the junction though not visibly imperfect is really so. Sometimes, for expedition, only every other fold is threaded, which, however, is an injury to the work, as in this case it requires coarser thread to make the junction secure, and therefore, small elevated lines appear on the surface of the plat, indicating the place of the thread and injuring the evenness of its surface, a defect which detracts from its beauty, and consequently from its value.

Fig. 9 shows the relative position of three loops *x y z*. (*x x* being repeated), with the thread passing within them; the loops are really adjacent, but are represented as separated in a direction the contrary of that in fig. 7, for the sake of perspicuity.

N° VII.

FINE BROAD CLOTH FROM NEW SOUTH WALES' WOOL.

The GOLD ISIS MEDAL *was this Session given to Mr.* T. STARKEY, *of Huddersfield, for* A PIECE OF FINE BROAD-CLOTH MADE ENTIRELY OF WOOL FROM NEW SOUTH WALES, *the produce of the Flocks of* J. M'ARTHUR, *Esq. A Specimen of the Cloth is preserved in the Repository of the Society.*

SEE COLONIES AND TRADE, No. I.

N° VIII.

NEW MATERIAL FOR HATS.

The Thanks of the Society were this Session given to Mr. W. PRITCHARD, *of Castle Street, in the Borough, for the introduction of a* NEW MATERIAL FOR HATS, *instead of Vigonia Wool.*

THE felt of the finer kinds of hats is made of rabbits' hair; but as hair alone will not undergo the process of felting, it is necessary for this purpose to mix with the rabbits' hair, a certain, but small proportion of the finer kinds of wool. That which has upon the whole been in most esteem for this purpose, is the wool of the Vicuña, a species of camel indigenous in Peru and Chili; which is known in commerce by the name of Vigonia wool, or red wool (from the peach-blossom tinge which it naturally possesses). This substance however, is brought here by a long navigation, and is often, from various circumstances, at an extravagant price. In consequence of this, the finer sorts of Merino wool, especially the Saxon, have been employed as a substitute with tolerable success.

The buffalo of Canada is furnished with long coarse hair, intermixed with a certain quantity of extremely fine real wool. The entire fleeces of these animals have long formed an article in the annual sales of the Hudson's Bay

Company; and Mr. Pritchard was induced at the suggestion of his brother, who had spent some years at Hudson's Bay, to make a trial of it as a substitute for the red wool. The first experiments were sufficiently successful to induce him to form an arrangement with his brother, in consequence of which, the latter returned to Canada, taking with him persons properly qualified to sort and select the wool to answer the expected demand.

Four or five cwt. of buffalo wool so sorted, were imported last year from Hudson's Bay; the quality of which, from the evidence produced before the Committee, appears to be intermediate between that of the real red wool, and the best Saxon Merino wool.

It appears also, that the buffalo wool has of late been very successfully employed in improving the quality of the fine Norwich shawls, and other similar articles.